Civilian Research Project
USAWC Fellow

SWORDS & PLOWSHARES: MODIFICATIONS TO THE MLRS FAMILY OF MUNITIONS

by

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Class of 2013

DISTRIBUTION STATEMENT: A
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REPORT DOCUMENTATION PAGE				*Form Approved OMB No. 0704-0188*

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. **PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

1. REPORT DATE *(DD-MM-YYYY)* xx-04-2013	**2. REPORT TYPE** CIVILIAN RESEARCH PROJECT	**3. DATES COVERED** *(From - To)*
4. TITLE AND SUBTITLE SWORDS & PLOWSHARES: MODIFICATIONS TO THE MLRS FAMILY OF MUNITIONS		**5a. CONTRACT NUMBER**
		5b. GRANT NUMBER
		5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) Colonel Robert C. Agans, Jr. United States Army		**5d. PROJECT NUMBER**
		5e. TASK NUMBER
		5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Dr. Joseph W. Caddell University of North Carolina - Triangle Institute for Security Studies		**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Dr. George J. Woods, III U.S. Army War College, 122 Forbes Avenue, Carlisle, PA 17013		**10. SPONSOR/MONITOR'S ACRONYM(S)**
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Distribution A: Approved for Public Release. Distribution is Unlimited.

13. SUPPLEMENTARY NOTES
Word Count: 6347

14. ABSTRACT
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15. SUBJECT TERMS
ATACMS, GMLRS, Anti-Access / Area-Denial (A2/AD), Joint Operational Access Concept (JOAC)

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT UU	**b. ABSTRACT** UU	**c. THIS PAGE** UU	UU	34	**19b. TELEPHONE NUMBER** *(Include area code)*

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Report Date: April 2013

Page Count: 34

Word Count: 6347

Key Terms: ATACMS, GMLRS, Anti-Access / Area-Denial (A2/AD), Joint Operational Access Concept (JOAC)

Classification: Unclassified

The nature of the challenges to the United States and its interests demand that the Armed Forces operate as a fully integrated joint team across the range of military operations. Complicating the operating environment are emerging trends in the growth of anti-access and area-denial capabilities around the globe and the changing U.S. overseas defense posture. Through their actions during both peacetime engagement and armed conflict, the military services must create and ensure flexibility and freedom of action for our elected government officials and military leaders. A potential solution for the joint force to create that flexibility and freedom of action is to modify the stocks and employability of the Multiple Launch Rocket System (MLRS) Family of Munitions (MFOM) to offer leaders more and complementary options across the range of operations and support. The modifications proposed are complementary and do not replace existing systems in any service. Rather, they seek to provide flexible, scalable, 24/7, long range, all weather assets to the list of options available to decision-makers. These modifications could not only coerce, deter or compel others but also provide assistance - acting as both swords and plowshares.

SWORDS & PLOWSHARES: MODIFICATIONS TO THE MLRS FAMILY OF MUNITIONS

The nature of the challenges to the United States and its interests demand that the Armed Forces operate as a fully integrated joint team across a wide range of military operations.[1] The growth of anti-access and area-denial capabilities and the changing U.S. overseas defense posture complicate the global operating environment.[2] Through their actions during both peacetime engagement and armed conflict, the military services must ensure flexibility and freedom of action for our elected government officials and military leaders. A potential solution for the joint force to create that flexibility and freedom of action is to modify the stocks and employability of the Multiple Launch Rocket System (MLRS) Family of Munitions (MFOM) to offer leaders more and complementary options, acting as both swords and plowshares, across the spectrum of conflict.

At the dawn of the 21st century, the United States of America faces a broad and complex array of challenges to its national security.[3] The global security environment presents an increasingly complex set of challenges and opportunities to which all elements of United States national power may be applied.[4] The rising demand for resources, rapid urbanization of littoral regions, the effects of climate change, the emergence of new strains of disease, and profound cultural and demographic tensions are just some of the trends which may spark or exacerbate future conflicts.[5] The implementation of sequestration, with associated current budget cuts and the likelihood of decreased funding in the future, further reinforces the need for teamwork in all areas across the U.S. Government, especially within the Department of Defense. A decrease

in available resources requires that all branches of the U.S. Government increase mutual cooperation and innovation to prepare for future contingencies and operations in support of national goals and objectives.

The joint force is one of several instruments of national policy maintained to help shape the international political environment in support of U.S. interests.[6] Joint forces must be able to project military force into any operational area in the face of armed opposition to secure national interests.[7] The U.S. Joint Operational Access Concept (JOAC) describes how joint forces will operate in response to emerging anti-access and area denial security challenges. Its central thesis is *cross domain synergy* - "the complementary [...] employment of capabilities [...] such that each enhances the effectiveness and compensates for the vulnerabilities of the others - to [...] provide the freedom of action required by the mission."[8] The [...] concept applies "first and foremost to fires as defeating opposed access and will require lethal and non-lethal fires, applied flexibly, and responsively between domains."[9] Should hostilities commence, the JOAC assumes risk by relying on deep, precise strikes to neutralize enemy anti-access and area denial systems from a distance.[10]

The proposed modifications are complementary and do not replace existing systems in any service. Rather, they provide flexible, scalable, 24/7, long range, all weather assets to the list of options available to decision-makers. Proposed modifications include (1) Funding the Army Tactical Missile System and Shelf Life Extension Program, changing its name back to the Joint Tactical Missile System to reflect its history and nature, and involving more of the joint force in the development of future capabilities; (2) Adapting the warhead sections of rockets and missiles to accept

modular payloads that can be selected as required or appropriate for the mission at hand; (3) Packaging appropriate sensors, special access program (SAP) and special technical operations (STO) technologies, non-lethal munitions and technologies, and lethal warheads into modular payloads to provide scalable and suitable effects; (4) Changing the level of maintenance and unit ammunition personnel's ability to access the munitions at the unit level and launch locations to allow for the changing of the payloads; and (5) Developing, testing and fielding: (a) surface and sub-surface vessel launch options for the U.S. Navy and (b) fixed location launch options for both the U.S. Army and Air Force, to provide commanders and leaders with scalable stand-off range options while reducing overall risk to their forces and manned air assets.

The proposed modifications are not necessarily new or unique. History, some of it very recent, is replete with examples of multi-service development and cooperation for the hardware and capabilities discussed. These modifications offer ideas for maximizing joint and interagency opportunities with minimal costs, relatively speaking to some programs or research and development costs for a new program start. This paper includes an overview of the current hardware and capabilities proposed for modification. The purpose is to support these modifications and ideas, to note the points of friction between the different services, and to provide poignant historical examples of multi-service cooperation and development. Finally, there will be recommendations for improving the hardware and capabilities that increase options across the spectrum to leaders and decision makers.

Current Hardware and Capabilities

The MFOM consists of surface-to-surface, conventional, tactical rockets and missiles that provide commanders a long range, all weather, day and night capability to delay, disrupt, and destroy threat forces and long range weapons at extended distances before they can influence the close battle. The munitions are packaged in a launch pod that contains either six rocket tubes or one missile housing in a containerized shipping, storage and launch frame.[11] MFOM are currently fired from the lightly armored, tracked carrier M270A1 MLRS launcher and the air transportable, wheeled M142 High Mobility Artillery Rocket System (HIMARS) launcher. The U.S. Army employs both the M270A1 tracked and M142 HIMARS wheeled launchers and the U.S. Marine Corps employs the M142 HIMARS wheeled launcher.

Rocket variants include M26-series ballistic and M30 / M31-series inertial / Global Positioning System (GPS) aided models that contain multiple dual purpose improved conventional munitions (DPICM) sub-munitions or a 200 pound unitary high explosive (HE) blast / fragmentation warhead for use against point or area targets at ranges from 15 to over 84 kilometers. An increased range is achieved by decreasing the payload carried in the different rocket variants. The M26-series of rockets are basic unguided, free flight, tactical rockets. The M30 / M31-series of rockets are precision guided munitions and are called Guided MLRS rockets, or GMLRS. The rockets fly at supersonic speeds and the time of flight to maximum range is approximately two-and-a-half minutes.

Effects are achieved when the warhead (1) functions at a pre-determined altitude to release and scatter sub-munitions over a known sized area target, or (2) explodes when the munition impacts or is a few meters above the ground, depending on target

presentation and effects desired, for a point target. Appropriate target types for rockets include personnel and soft or light armor vehicles, such as artillery, multiple rocket launchers (MRLs), air and missile defense, and lightly armored maneuver units. GMLRS possess the ability to shape their terminal attack paths to follow ballistic or vertical trajectories.

Missile variants include M39 inertial and M39A1 / M48 / M57 GPS aided models that contain multiple Anti-Personnel / Anti-Materiel (APAM) sub-munitions or a 500 pound unitary HE blast / fragmentation warhead for use against point or area targets at ranges from 25 to over 300 kilometers. The increased range is achieved by decreasing the payload carried in the different missile variants. All missiles are referred to as the Army Tactical Missile System, or ATACMS. The missiles fly at supersonic speeds and the time of flight to maximum range is approximately six minutes. Due to their speed and low radar cross section, missiles are virtually undetectable by enemy radars. A previous missile variant designated the Block II Brilliant Anti-Tank (BAT) missile, discontinued since 2003, contained 13 acoustic and infrared guided sub-munitions that, after dispersal and gliding to a pre-programmed target area, could independently identify, track and engage moving tanks and other armored vehicles.

Effects are achieved in the same manner as rockets: when the warhead (1) functions at a pre-determined altitude to release and scatter sub-munitions over a known sized area target, or (2) explodes when the munition impacts or is a few meters above the ground, depending on target presentation and effects desired, for a point target. Appropriate target types for missiles include personnel, trucks, missile rounds, thin-skinned vehicles and radar antennas. Terminal attack trajectories for missiles

cannot be shaped and are either ballistic or vertical, depending on the missile employed.

The U.S. Army decided to withdraw funding for ATACMS in order to pay for other higher priority modernization efforts, cancelling the program. All ATACMS in the current inventory have been granted time extension waivers on certain internal components. The ATACMS Shelf Life Extension Program (SLEP) was an initiative to refurbish the missiles with certain upgraded components, guidance systems, and unitary HE warheads to extend the munitions' functional timeframe, but was declined funding by the U.S. Army leadership for other priorities. The current stock of ATACMS will "age out" in 2019, with no more waivers available, and the entire inventory will have to be demilitarized.

The sub-munitions used in the rockets and missiles do not have a 100% reliability of functioning rate when activated and leave some amount of unexploded ordnance (UXO) in the target area, which may cause unintended collateral harm to civilians and civilian infrastructure. The percentage of UXO remaining, also called 'Explosive Remnants of War' (ERW), is greater than allowed under the international agreements contained in the United Nations Convention on Conventional Weapons (CCW). Without an ATACMS SLEP or replacement warheads, MFOM containing DPICM or APAM sub-munitions must be demilitarized by 2018 to remain in accordance with the U.N. CCW and supporting Department of Defense cluster munitions policy. The U.S. Army has recently selected a high explosive type replacement warhead for the still funded rocket programs.

Since entering the inventory, rockets and missiles have supported the joint fires requirements of all services and some coalition partners in combat. Rockets and ATACMS were used in Operations Desert Storm, Enduring Freedom (OEF) and Iraqi Freedom (OIF) against a variety of targets.

As of mid-January 2013, a total of 2,524 GMLRS-Unitary warhead rockets were fired in OIF and OEF: 1,032 were shot by U.S. Army units; 675 by U.S. Marine Corps units; and 817 by British units. Of the 1,032 GMLRS-Unitary rockets shot by U.S. Army units, 782 were pre-planned fires and 250 were shot in support of troops in contact, with 803 rockets shot for Army units, 123 rockets for Marine units, and 106 rockets for other coalition or special operations units.[12]

As of late June 2012, 528 ATACMS were fired in OIF and OEF, all of them shot by U.S. Army units, with 470 shot in the initial OIF conflict and the other 58 shot in support of counterinsurgency operations. Of the total missiles shot, 331 were pre-planned fires and 197 were shot against time sensitive targets, with 290 missiles shot for the U.S. Air Force, 161 for the U.S. Army, and 77 shot for the U.S. Marine Corps.[13]

Points of friction between the different services

Throughout history, states have repeatedly employed military force in attempting to persuade other states to do their bidding.[14] Short of armed conflict, states use elements of their national power to deter, coerce, or compel the behavior of others in order to achieve conditions favorable to themselves. Both coercion and deterrence focus on influencing an adversary's calculations for decision making.[15] Deterrence seeks to maintain the status quo by discouraging an opponent from changing its

behavior.[16] By contrast, coercion seeks to force an opponent to alter its behavior by manipulating costs and benefits.[17] When deterrence and coercion fail, states are left little choice but to initiate hostilities.

Committing ground forces in a conflict means committing the nation. From Woodrow Wilson to William J. Clinton, presidents and their senior advisers have frequently turned to air power for quick and relatively cheap solutions to difficult diplomatic and security problems, overestimating the potential of military aviation to solve the nation's national security problems with a minimum expenditure of American blood and treasure.[18] Robert Pape postulates that "as the American public's willingness to bear military costs declines, the role of air power in overseas conflicts is increasing because it can project force more rapidly and with less risk of life than land power and more formidably than naval power".[19] Therein lies the rub.

At the macro level, all conflicts are about the attrition of an adversary's fielded forces, war-making capacity, and/or will to fight. In order to achieve a position of advantage created through attrition, one must be able to impact an adversary without sustaining greater losses, often by using weapons with greater stand-off ranges to protect one's own forces. Adversaries develop measures, countermeasures, and counter-countermeasures to compensate for potential adversaries' advances in technology that increase accuracy, effectiveness, and especially stand-off ranges. Compared to the cost of building and maintaining aircraft, training the crew, and providing basing, communications, aerial refueling, air superiority, and other support[20], less expensive systems such as artillery, air defense, and cruise missiles are logical alternatives for some states. These states often choose the larger 'quantity' of modern,

capable systems over the perceived 'quality' of advanced technology, in order to create a greater deterrent effect.

Since the beginning of manned flight, there has been friction and inter-service rivalry between ground forces and air forces over roles and missions, division of the battlefield, employment of joint assets, targeting priorities, and more.[21] The services largely agree, in principle, on the 'ways', but disagree on the 'means' and 'ends' that support and accomplish the 'ways'. Some of that friction endures to this day and is undoubtedly exacerbated by service perspectives, cultures, and competing visions of warfare. That friction is further complicated by different interpretations of historical events and resulting lessons, and the unending competition for funding of programs.

The services, and most literature on the subject, agree that the key to victory in conflict is to gain and maintain the initiative. In order to gain the initiative, one must carry the war into the enemy's territory in order to destroy his war production capability and to affect the morale of his leaders, soldiers, and civilian population. Gaining the initiative can be achieved by either ground or air forces, but the ability to maintain the initiative requires control of the air to "deprive the enemy of his ability to retaliate on a comparable scale".[22]

The desired end state of control, also command, of the air is air supremacy, because it then allows one to freely impose their unhindered will on their adversary. Air forces seek to gain superiority, at least, in the air before turning to supporting tasks, especially when faced with an enemy with large numbers of modern aircraft. Superiority in the air has become the prime condition for effective application of land and sea power.[23] In fact, Army doctrine "is predicated on constant friendly air superiority over

the battlefield"[24] to enable its ability to conduct offensive operations and provide flexibility to react to developing situations. Stefan Possony noted that "the air force that wins and retains command of the air has virtually decided the conflict."[25] Yet air power alone did not win World War II. Rather, that war was planned to be won by triphibious power, and by triphibious power it was decided.[26] This historical fact held true for the United States across all conflicts in the 20th century, is currently the basis for joint operations and planning, and is where the military services diverge on the 'means' and 'ends' necessary to achieve victory in conflict.

The Air Force, and to a degree naval aviation, believe that the means to gain and maintain the initiative is through strategic attack. The current United States Air Force Service Task List defines strategic attack as "offensive action aimed at generating effects that most directly achieve our national security objectives affecting an adversary's leadership, conflict sustaining resources, and/or strategy". Early airpower theorists, such as Douhet and Mitchell, believed that bombing the civilian population, and breaking their will to support the war effort, would generate those effects faster than only bombing field forces and war making capacity. Sir Hugh Trenchard, the foremost British proponent of strategic bombardment between the world wars, stated "It is not...necessary for an air force, in order to defeat the enemy nation, to defeat its armed forces first. Air power can defeat that intermediate step, can pass over enemy navies and armies, and penetrate air defenses and attack direct the centres of production, transportation, and communications from which the enemy war effort is maintained".[27]

The United States Army finds itself faced with much different challenges to gain and maintain the initiative. These challenges shape their perspective in much different

ways. While air forces and Army airborne / airmobile units can maneuver in the 'third dimension**,’** conventional ground forces must fight through enemy forces in a linear fashion and are therefore subject to terrain and the effects that weather, natural and man-made obstacles and canalization have on that terrain. Due to the inherently close proximity to hostile forces, ground forces are also subject to attrition by persistent indirect fires from mortars, cannons, rockets and missiles designed to take advantage of stand-off ranges. For these reasons, ground forces care more about these indirect fires threats than they do about an adversary's war-making capacity.

As previously described, because modern, advanced air forces are expensive to obtain and maintain, some states choose greater quantities of less expensive, lower technology weapons to create an overall greater deterrent effect. This increase in number of enemy systems compounds problems for ground forces because those lower technology weapons usually do not make the initial cut for engagement by air forces, leaving those enemy weapons to engage friendly ground forces. This target priority and engagement challenge is another example of where the United States Army and the Air Force diverge in their thinking with respect to gaining the initiative. This is not to suggest that one service is more correct in their thinking, rather it is only to highlight perspectives about one of the more important differences, and enduring disagreements, about 'initiative' and 'carrying the war into enemy territory'.

Historical examples of multi-service cooperation and development

Airpower theorists throughout the ages defined 'air power' as "the ability to use platforms operating in or passing through the air for military purposes.”[28] Historical

analysis reveals that a rocket or missile body, just like an airframe, is an effective platform for delivering effects, whether for military purposes or even humanitarian reasons, and meets the 'air power' definition.

From 2005 to 2008, while working in a Fire Support / Combat Development job for the United States Special Operations Command (USSOCOM), I worked on several projects to quickly develop, expand or integrate long-range missile fires into fielded capabilities to support the Global War on Terror. I was the project officer for an M142 HIMARS enhanced initialization capability, known as the 'HIMARS Hot Panel', that allowed a HIMARS launcher to initialize its onboard fire control panel, load onto and fly long distances aboard a C-17 cargo aircraft, and track GPS satellites while in flight, to allow for immediate fire mission capability once the C-17 landed.[29] The 'Hot Panel' capability saved at least 30 minutes of overall launcher initialization time, became a required capability for the 82nd Airborne Division and its Forcible Entry mission requirements, and laid the groundwork for a similar U.S. Marine Corps capability to provide immediate fire support while still loaded on ships.

I also spent several days underway on a *Los Angeles* class submarine to determine the feasibility of that platform and integration requirements to shoot ATACMS in addition and complementary to its Tomahawk Land Attack Missile (TLAM) capability. Since the TLAM was considered a 'strategic weapon' by decision makers, the addition of ATACMS provided a lower cost, faster reaction, quicker time of flight option that increased the sub's flexibility and support for conventional and special operations forces. I thought I was breaking new ground. Little did I know at the time that I was actually repeating history.

A review of historical documents shows that all of the services have collaborated on various methods to deliver effects from stand-off ranges in order to reduce overall risk to mission and to forces. Specifically, every service has evaluated the use of ATACMS as one of those means and found it to be a feasible option. For various reasons, some financial and some force modernization driven, other services chose to follow different paths.

The first organization dealing exclusively with guided missiles was established early in 1945 by the Joint Chiefs of Staff for the purpose of reviewing projects concerned with the development of rockets comparable to the German V-1s and V-2s.[30] In the separation of the Air Force from the Army, the Air Force was relieved, effective 19 July 1948, of its responsibility for the guided missiles research and development program required to accomplish roles and missions of the Army.[31]

The Joint Tactical Missile System (JTACMS) was a Defense Advanced Research Project Agency's (DARPA) program in the late 1970s and early 1980s originally aimed to develop a common Air Force - Army standoff precision attack missile.[32] DARPA's "Assault Breaker" program in the early 1980s combined the JTACMS with an airborne radar aircraft, which became the Joint Surveillance Target Attack Radar System (JSTARS), in a concept designed to attack and defeat massed Soviet armor deep in enemy territory with precision guided conventional weapons rather than nuclear weapons.[33]

The Integrated Acquisition and Strike System (ITASS) concept was successfully tested using JTACMS and JSTARS in December 1982 but further implementation as a joint integrated reconnaissance / strike capability by the Army and Air Force was never

completed due to divergent focuses and priorities of the services.[34] The JTACMS program was restructured to allow separate yet complementary systems but was later abandoned by the Air Force altogether in favor of cruise missile development.[35] The Army received approval to continue the program and renamed the missile 'ATACMS'.

In 1975, the Defense Science Board convened a task force to conduct an independent assessment of the analytical tools and models employed in the Department of Defense's Deep Attack Weapons Mix Study (DAWMS) effort.[36] The report reinforced a 1995 congressionally-mandated heavy bomber study that concluded that U.S. conventional deep strike capabilities could best be served by expenditures on precision weapons rather than purchasing more B-2 bombers.[37]

While the major focus of the report was on weapons and combat modeling procedures, the resulting report was interesting for several reasons. First, and most interesting, the report highlighted that campaign modeling procedures did not include potential enemy tactics, such as restraint, tactical patience, and various types of asymmetric attacks involving new types of specialized systems, that could transform the basic structure and assumptions on the campaigns.[38]

Second, the report reinforced that "military forces should not be point designed for one or two specific scenarios", rather "military forces should be designed to handle a range of threats to national security with sufficient robustness to respond to unpredicted events as well as those predicted".[39] Third, and probably most importantly, the report stated that due to uncertainty and unpredicted events "military force options should be evaluated not only for their war-fighting capability but also that they (1) increase the U.S.'s ability to shape the future international security environment, and (2) provide

hedges against uncertainties such as the location and possible forms of future aggression."[40]

These results call into question some of the modeling that was done to support the justification for and acquisition of various, unspecified major weapons systems programs. More importantly, the report lends credence to the need for adaptable, flexible and scalable options for shaping the security environment and compensating for uncertainties in location or type of aggression.

In early 1995, the U.S. Navy formally approved plans to develop a navalized version of ATACMS, known as NTACMS, compatible with existing vertical launch system (VLS) tubes to give surface ships and submarines an improved naval fire support capability.[41] Proof of concept, limited integration**,** and firing tests of ATACMS were conducted in February 1995 aboard the USS *Mount Vernon* (LSD-39), using a standard M270A1 launcher. Another test was conducted in 1996, fired from VLS tubes.[42] The Navy considered the NTACMS, in conjunction with cruise missiles, as potential munitions to fill the almost 500 VLS tubes for their 'Arsenal Ship' floating missile platform concept, subsequently cancelled, to provide a range of depth, flexibility and effects to commanders and leaders . In late 1995, the United States Navy's Strategic System Program Office authorized a study to evaluate the launch of tactical battlefield ballistic missiles from the 688I *Los Angeles* class fast attack submarine for a self-contained undersea cold launch capability.[43] The ATACMS missile was chosen based on the production status, combat history, range and payload making it ideal for fire support from the sea.[44] The Sea Launched TACMS (SLATACMS) was a derivative of the ATACMS Block 1A missile with changes to accommodate the dimensional

constraints of the submarine's vertical launch cells, to accommodate the submarine environment by adding a rear fin module that provided stability during underwater flight before being jettisoned, integration with existing submarine systems, and to allow for different launch and flight conditions.[45] The study showed the feasibility and ability of launching the ATACMS from the SSN688 class submarines. The programs were never funded, however, due to competing programs and the terrorist attacks of September 11, 2001.

Recommendations for improving the hardware, capabilities and friction

Proposed modifications include**:** (1) Funding the Army Tactical Missile System and Shelf Life Extension Program, changing its name back to the Joint Tactical Missile System to reflect its nature, and involving more of the joint force in the development of future capabilities; (2) Adapting the warhead sections of rockets and missiles to accept modular payloads that can be selected as required or appropriate for the mission at hand; (3) Packaging appropriate sensors, special access program (SAP) and special technical operations (STO) technologies, non-lethal munitions and technologies, and lethal warheads into modular payloads to provide scalable and suitable effects; (4) Changing the level of maintenance and unit ammunition personnel's ability to access the munitions at the unit level and launch locations to allow for the changing of the payloads; and (5) Developing, testing, and fielding (a) surface and sub-surface vessel launch options for the U.S. Navy, and (b) fixed location launch options for both the U.S. Army and Air Force, to enable commanders and leaders with scalable stand-off range options while reducing overall risk to their forces and manned air assets.

Modification #1 - The flexibility, adaptability and scalability that current and potential ATACMS program offers to leaders present a synergistic opportunity that greatly increases their options while minimizing risk to forces and platforms. In a time of fiscal constraints, partial funding of the Army Tactical Missile System and Shelf Life Extension Program makes sense to bridge the gap between the expiring existing stocks of ATACMS and development of a replacement system. Changing its name back to the Joint Tactical Missile System reflects the historical efforts by the services and the munitions true nature as a joint asset. The natural by-product of that change is then to involve more of the joint force in the development of future capabilities to ensure continued success.

Modification #2 - Adapting the warhead sections of rockets and missiles to accept modular payloads provides the flexibility of political and military leaders to ensure the use of the 'right tool for the right job' at the right time. In 2001, Lockheed Martin developed a multi-functional 'Universal Dispenser' for the ATACMS capable of delivering radial, aft and spinning dispense for various types of domestic and foreign sub-munitions in single, staggered and multiple dispense options at subsonic and supersonic velocities.[46] The prototype is configured with four quadrants, but is easily converted to a three-quadrant configuration with a sharper nose to increase aerodynamics, thus increasing range.[47]

Currently, rockets and missiles are only available as pods of one type or another, each pod weighing approximately 6,000 pounds. Unit personnel must guess the amounts and types of the different MFOM they will require throughout any operation as well as the timing, and therefore the placement on the battlefield, of all of the required

pods. If a different type of effect or munition is desired, an entirely different 6,000 pound pod must be on hand or transported to the launcher location. Modular payloads would allow all individual munitions the potential to be used, which provides increased options and more flexibility to leaders at reduced costs because those payloads scale down the sizes and weights of alternatives and reduce wartime transportation requirements.

Modification #3 - Packaging appropriate sensors, special access program (SAP) and special technical operations (STO) technologies, non-lethal munitions and technologies, and lethal warheads into modular payloads will provide leaders with options for scalable and suitable effects. Humanitarian and other relief supplies could also be packaged and delivered at long-ranges if weather conditions preclude or prohibit the use of fixed wing aircraft or ships.

In the four-quadrant configuration using existing munitions, the Universal Dispenser carried four (4) joint Army / Air Force Low Cost Autonomous Attack System (LOCAAS) sub-munitions, 32 Army Seek and Destroy Armor Munitions (SADARMs) or Air Force skeet warheads (BLU-108), eight (8) Army BATs or 16 Army Wide Area Munition (WAM) sub-munitions.[48]

Theoretical options for future payload options include:

(1) Electro-magnetic pulse (EMP) equipment to paralyze operating enemy vehicles or command, control and communications (C3) equipment;

(2) Non-lethal options such as (a) malodorants, to disperse crowds or remove individuals from confined spaces, and (b) dyes, to overt or covertly mark personnel, equipment or vehicles for identification or tracking;

(3) Low collateral damage, scalable options such as Dense Inert Material Explosive (DIME) or thermobaric payloads;

(4) Foreign developed options such as the Israeli 105mm Anti-Personnel / Anti-Materiel (APAM). The Israeli APAM contains six (6) explosives charges with multiple fuzing options. In the point detonating (PD) mode, all six charges are detonated simultaneously to destroy armored vehicles, breach walls, or as a 'bunker buster'. In the timed mode, the six charges are ejected at designated intervals and detonated in air to provide effects on prone or entrenched combatants, or to provide an effective fragmentation flak screen against helicopters, unmanned drones or manned aircraft;[49] and

(5) Other foreign developed options such as the Israeli Delilah cruise missile. The Delilah is an air launched cruise missile, with a range of more than 250 kilometers, that contains a television uplink back to the launching cockpit. The uplink allows the plane's navigator to control the missile to a designated area, view that area while loitering until target conditions are met, and conduct terminal attack when appropriate. Should anything go awry before missile impact, the navigator can command the missile to re-enter the loiter mode until the issue is resolved and target conditions are met again.[50]

One example of synergy created by this concept was theoretical humanitarian support to Pakistani officials after the Siachen glacier avalanche in April 2012, which buried over 150 Pakistani soldiers and civilians under 60 feet of snow. Rescue efforts were seriously hampered by extreme weather that lasted for several days, with any chances of finding survivors decreasing rapidly. In this extreme weather support

scenario, rockets or missiles filled with heat detecting and acoustic sensors are fired and dispersed over the disaster area. These sensors transmit data back to the emergency headquarters to confirm / deny survivors and help focus rescue efforts. If survivors are located, munitions containing rescue supplies of food, water, blankets and other cold weather survival gear are fired into those specific areas to assist them until rescuers can reach them.

Another example of synergy is theoretical combat support against a peer adversary with a sophisticated air defense system. Missiles loaded with APAM warheads, followed closely by missile(s) loaded with EMP payloads, are fired from ships or land-based launchers and timed to function just before friendly aircraft enter the maximum detection range of enemy air defense radars. The mix of the different munitions allows the APAM warheads to inflict damage on the enemy air defense radars, launchers, support equipment and personnel though blast and fragmentation, while the EMP payload paralyzes the target's radars electronics and communications equipment.

A final example of synergy is theoretical combat support to SCUD missile launcher hunting. Missiles loaded with Delilah cruise missiles, fired from ship or ground based launchers, deploy the Delilahs to the vicinity of a suspected enemy ballistic missile launcher deployment area. A friendly air strike package, carrying lethal bombs instead of Delilahs on their wing pylons, loiters outside of enemy air defense threat rings and controls the Delilah missiles around the target area so that the package's visual and audible signature does not 'spook' the enemy launchers. When the enemy launchers come out of their concealed hide positions, the Delilah operators terminally guide those

cruise missiles to attack the SCUD launchers. After their assigned Delilah missiles attack, the controlling aircraft, since it still has lethal munitions under its wings, can be re-tasked to attack other targets of opportunity.

Modification #4 - The recommendation for changing the level of maintenance and unit ammunition personnel's ability to access the munitions at the unit level and launch locations to allow for the changing of the payloads naturally follows from modifications #2 and #3. This change ensures that the appropriate modular payload can be loaded quickly and efficiently so that the scalable and desired effect is achieved. Currently, unit personnel can only hook up a maintenance test device to a port on the launch pod to run a 'munitions health' sequence. If there are any issues, the entire launch pod has to be evacuated out of theater back to depot level maintenance stateside. Changing the level of maintenance would also allow low to mid level faults to be corrected forward, which increases the munitions available to the joint force and interagency. Launcher maintenance and ammunition personnel would require training, updated test devices and tools, mock-up training devices for practice, and a bench stock of repair parts.

Modification #5 - As detailed above, feasibility studies, initial concept testing, and limited integration work is complete for both U.S. Navy surface and sub-surface vessel launch options. A fixed location launch option for both the U.S. Army and Air Force is available by repurposing existing or building more Navy Harpoon missile racks, which hold two launch pods each, and integrating them into the Army's distributed digital command and control or joint fires network. Due to the in-flight maneuverability of the MFOM, launch racks can be fixed on concrete pads pointing in the general direction of the targeted area and the munition can adjust its trajectory path in flight. These fixed

launch racks could be used in support of base or garrison defense and to provide leaders with deterrent and coercive means.

For deterrent effects, the greater number of networked launch pods mounted on racks allows leaders the ability to place either live munitions for combat use or weighted empty pods for use to deceive adversaries as to the actual threat they are facing. For coercive effects, these fixed locations increase the immediately available number of launch pods available for long-range precision effects. This increased number of munitions allows flexibility for the Joint Force Commander (JFC) to reallocate and reapportion his assets to increase initial strike options, potentially reduce air package sizes and protection requirements, and enhance effectiveness while decreasing overall risk to force, which can also provide a deterrent effect for adversaries.

For air-delivered options, changing the rocket and missile flight profile software to allow a horizontal launch from a B2 Spirit or other bomber offers a stand-off weapon with better range, faster time of flight, and target area trajectory shaping options than some of the existing ground and air-launched options. Also, experimentation with the Joint Precision Air Drop System (JPADS) should be explored to provide an expeditionary or 'thru-the-weather' capability to austere or remote locations where aircraft are unable to land.

Conclusion

As discussed in this paper, the proposed modifications to existing stocks and employability of the MFOM make operational, strategic and fiscal sense. These modifications will create cross domain synergy and increase the options and capabilities

available to leaders, acting as both swords and plowshares, by providing adjustable and scalable effects across the spectrum of conflict. The munitions' reaction time, time of flight, speed and virtually undetectable low radar cross section reduces the overall signature, which may increase chances for surprise and mission success compared to other platforms. Use of these modified systems increases mission effectiveness and decreases the 'strategic risk' of losing the man in the cockpit by allowing for parallel, vice sequential, application of effects across the complete range of prioritized targets. This method allows for a potential reduction in the size of force protection packages which further expands target coverage. Finally, modifying existing, combat proven systems is fiscally responsible and helps to minimize duplication of efforts across services.

Endnotes

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